

SCIENCE NEWS-LETTER

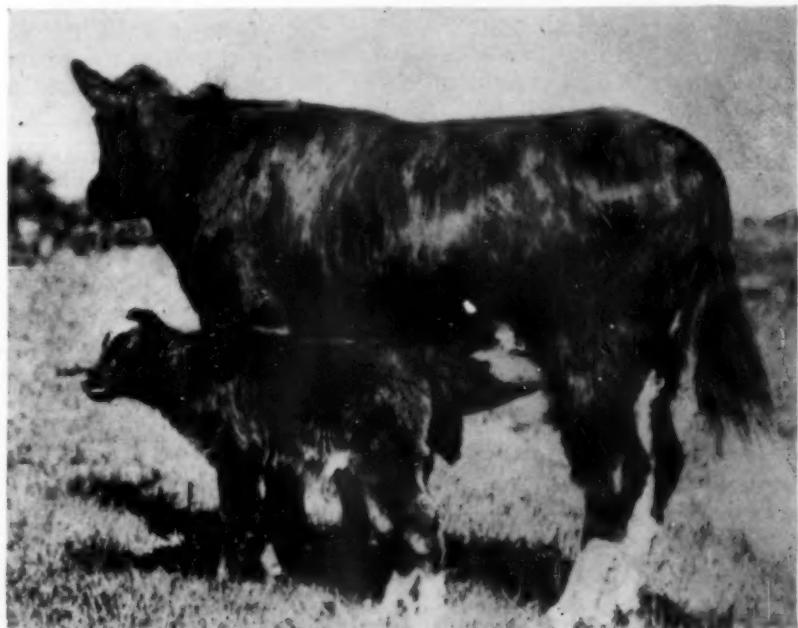
The Weekly Summary of Current Science
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March 30, 1929

SCIENTIFIC BOOK
COLLECTION
OF MICHIGAN



INTRODUCING THE GALYAK

Hybrid Between Yak and Galway Cattle, Recently Bred in Canada

(See page 191)

3,400,000,000 Years Young

Geophysics

Old as our earth is, its age cannot be more than about 3,400,000,000 years. This is the conclusion reached by Sir Ernest Rutherford, famous British physicist and Nobel prize winner, and expressed in a communication to the British scientific journal, *Nature*.

It is reached from a study of photographs made by Dr. F. W. Aston, of the Cavendish Laboratory at Cambridge, with an instrument called the mass spectrograph. By means of this instrument it is possible to make photographs which show the weight of the atoms of many elements. Dr. Aston has shown, with its aid, that many elements consist of two or more separate kinds of stuff, with slightly different atomic weights, though they are all the same element. These different forms of the same element are called isotopes. Ordinary lead, for instance, consists of several such isotopes. One lead isotope is obtained as the final result of a series of elements into which radium disintegrates.

Dr. Aston has studied lead from a rare Norwegian mineral, called bröggerite, extracted for him by Dr. C. S. Piggot, of the Geophysical Laboratory of the Carnegie Institution of Washington. In his photographs he found a line showing the presence of lead of atomic weight 207. This, he concluded, cannot be ordinary lead. As there are three radioactive series, namely, radium, thorium and actinium, two of which break up into some kind of lead, he decided that the 207 isotope is the result of the break-up of actinium, of which less is known than of the other two series.

Sir Ernest, who is one of the greatest authorities on radium and its allied elements, states that Dr. Aston's conclusion is a reasonable one. Both radium and actinium are descendants of uranium, a well-known element. Sir Ernest believes that a form of uranium that he calls actino-uranium is one of the ancestors of actinium. Actino-uranium, he concludes, is present in ordinary uranium to the extent of about a quarter of a per cent.

"It is natural to suppose that the uranium in our earth has its origin in the sun," he says, "and has been decaying since the separation of the earth from the sun."

Because of the behavior of similar

elements, he believes that the actino-uranium would be formed in the sun to a less extent than the main isotope. But even if it is supposed that they were formed in equal quantity, he says, it can be shown that it would only take about 3,400,000,000 years to bring it down to the twenty-eight hundredths of one per cent. in which it is present today.

"If we suppose that the production of uranium in the earth ceased as soon as the earth separated from the sun," he continues, "it follows that the earth cannot be older than 3,400,000,000 years."

Other studies of radioactive minerals have shown that some of them must have an age of at least half this figure, so that his calculations give students of the earth's early history both a maximum and a minimum for its age.

Sir Ernest also cites Sir James Jeans, British astronomer, who gives a figure for the age of the sun as

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7,000,000,000 years. If the earth separated from it 3,400,000,000 years ago, the sun had then reached the rather respectable age of 6,996,600,000,000 years. The time since is scarcely more than a moment in the sun's history.

However, if the actino-uranium could only have been formed under special conditions in the sun when it was very young, it would have all disappeared when the earth was born.

"We may thus conclude," remarks Sir Ernest, "I think with some confidence, that the process of production of elements like uranium was certainly taking place in the sun 4,000,000,000 years ago and probably still continues today."

Science News-Letter, March 30, 1929

It is more difficult to lay cables in the Pacific than in the Atlantic, because of the deeper ocean bed and the greater distances between land.

INTERPRETING week by week, the latest developments in the various fields of science, this magazine attempts also to present its articles in the most pleasing and readable typography and the most convenient arrangement.

The *clippability, indexing, and automatic dating* of each article are unique features.

This is a *separable magazine*. Each original article can be clipped or torn out without losing or damaging another important article on the other side. These original articles are backed by reprinted quotations or excerpts, short one-sentence items, advertisements, and other material not likely to be clipped and preserved.

Each article is automatically *indexed* by the key word printed in *italics* just below the heading, or at the end of the article when the article has no heading. Articles can thus be filed easily into any system of classification, whether it be Library of Congress, Dewey, or one of the reader's own devising.

Each article is automatically *dated* by its last line.

All of the resources of Science Service, with its staff of scientific writers and correspondents in centers of research throughout the world, are utilized in the editing of this magazine.

America a Melting Pot for Animal Stocks

By FRANK THONE

In the old West, the hard-riding, hard-hitting, hard-drinking West, where you called a man "pardner" on sight and bought him a drink, it was not considered good form to have curiosity concerning where a man came from, or to inquire overmuch into his ancestry or antecedents. The great open spaces of those days were the mouth of an undiscriminating melting pot into which all kinds and conditions of human materials were dumped and out of which some of the most amazing human alloys—both good and ill—have been poured.

The human melting pot west of the Missouri is quieter now, though it still simmers; but from the Gulf to Bering Sea another melting pot has been set a-cooking. Into it go various domestic animal stocks, both immigrant and native, and out of it shall come—if the preliminary samples be any basis for judgment—new races of beasts such as have not been seen since Noah, ancestor and patron of all stockmen, stood at the loading-chute of the Ark. Crosses between cattle and the native bison, between cattle and long-haired yaks from the Himalayas, between Siberian reindeer and Alaskan caribou, between fat-tailed sheep from Persia and domestic sheep from England, are among the new citizens of the North American West.

There won't be any undesirable citizens among them. Such will be born, no doubt, but the breeder can weed them out as infants. They do not have a chance to survive, as did some of their human prototypes, who later succeeded in escaping even the sheriff's six-gun or the ready noose of a Vigilance Committee. That is one advantage the animal melting-pot has over the human one. The undesirable animal crosses are either eliminated at once or survive only as caged-up curiosities, to show breeders how not to do it next time.

The secret behind the efforts of breeders to produce cattle hybrids of kinds that were never seen even in the prophetic dreams of Pharaoh is to be found in a climatic and geographical paradox. The "cow country" of our West is really not cow country at all. At least it isn't in the modern economic sense, which considers book-keeping more closely than it does romance. The breeds of beef cattle that have become standard in this country originated in Western Europe on rich



THIS FINE-LOOKING HORSE is one-quarter mule; he is the grandson of Old Beck, the maternal mule of Texas

pastures where blizzards never howled, and where there was shelter from even the relatively mild storms that did come. Their names tell that: Angus, Durham, Hereford, and so on. They have furthermore been bred in this country to meet the needs of the moderately humid East and not to face the sterner life of the thin-grassed Western range, where they must shift for themselves as best they can even when a "norther" catches them in the open. The old Spanish cattle, famous in a thousand novels and movies as "Texas longhorns", came of a stock more easily adapted to drought and cold. But they were not shaped right for modern beef fashions, and had to give way before the Eastern breeds, which affected the box-car silhouette, and carried more meat aft.

Because these could not stand the climate so well and because they fell easier victims to the terrible tick-borne fever, stockmen early began casting about for possible hardy mixtures to add to their blood. The first possibility, naturally, was the native American buffalo or bison. Most of these ancient "cattle of the Indians" had been wiped out in the terrible slaughter of the '80's, but a few cattlemen,

either more sentimental or more farsighted than their contemporaries, had kept small private herds going on their ranches. Here was a bovine stock inured to Western range life, able to travel and feed at the same time, heedless of blizzards, resistant to disease.

So they tried crossing bison and cattle. The results at first were not an unqualified success. Domestic cows bore calves in a fair proportion of cases, though frequently with considerable trouble, and at first the offspring were all heifers. It was thought that in such a cross bull calves could not be born alive. The trouble was, that though such hybridization had been tried sporadically for more than a hundred years, it had never been tried on anything like a large scale. Finally, however, Mossom M. Boyd, a Canadian breeder, succeeded in obtaining a bull that was almost one-half bison, by mating a pure-bred bison bull with cow that had one-quarter bison blood in her. A number of other male calves with a high percentage of bison blood have been obtained. With these the experiments are being continued in Canada, where the shaggy mane of the bison is of especial value in (Turn to next page)

America a Melting Pot for Animal Stocks—Continued

protecting the animal against the blinding snowstorms that sweep the range.

The great hump of flesh on the bison's shoulders tends to be reproduced in the domestic-cross offspring also, so that Mr. Boyd has said, "It does not seem unreasonable, therefore, to suggest that the fur of the bison and his great back may be carried by means of selection without any diminution through succeeding generations of diminishing bison blood until the coat and hump have been practically taken from the bison and placed upon the back of the domestic ox."

Charles Goodnight, a pioneer breeder of Texas, agrees with Mr. Boyd in his high estimate of the cattle-bison cross. "They are immune from all diseases as far as I have tested them," he has stated. "They are much greater in weight, eat much less and hold their flesh better under more adverse conditions. . . . They have a better meat, clear of fiber, and it never gets tough like beef. They have long and deep backs, enabling them to cut at least 130 pounds more meat than other cattle. More of them can be grazed on a given area. They do not run from heel flies nor drift in storms, but like the buffalo face the blizzards. They rise on their fore feet instead of their hind feet. This enables them to rise when in a weakened condition. They never lie down with their backs down hill, so they are able to rise quickly and easily. This habit is reversed in cattle."

The name of the final product of the cross-breeding of cattle and bison is itself a cross: "cattalo". Several spellings were put forward, but this one was accepted as standard by the American Genetic Association, of Washington, D. C.

A more recent cattle hybrid than the cattalo, but one which has been more favorably received in the Texas area, is the cross between the humped zebu, or sacred Brahmin cow of India, with domestic stock. It was discovered that the zebu does not fall victim to the tick-borne cattle diseases that take heavy toll of the native stock of European origin. Since the zebu is more nearly related to domestic cattle than is the bison, the two species amalgamate more readily and there is less loss in breeding. Moreover, after a couple of generations a "grade" animal shows little sign of the Indian admixture, but looks very much like its European ancestors. This, of course, interferes less with conventional market requirements.

For these reasons, males with Brahmin blood in them have come to be in considerable demand in the tick-infested parts of the Southwest. Since quarantine regulations do not permit the importation of any more breeding stock from the Orient, there are relatively few full-blooded zebu bulls in Texas, and the highest proportion of Brahmin blood usually encountered runs from three-fourths to seven-eighths.

From a much more remote quarter of the world than the Southwest, and closer to the zebu's own home, a weird outcross has been reported to the American Genetic Association, although that organization discreetly declines to vouch for its authenticity. This is the offspring of a Philippine carabao, or water buffalo, which unlike our bison, is a real buffalo. This animal looks as though it might have been sired by a zebu; at any rate, it is very queer looking for a carabao. But when all is said, the verdict will probably have to remain like that in many another doubtful case east of Suez: "the paternity remains in doubt."

To return to our own continent again. Up in Northern Canada, where the Dominion government maintains the greatest bison ranch in the world, they have been trying out another Asiatic animal as a possible contributor to the solution of the range-cattle problem. This is the yak, a long-haired, brush-tailed, slow-moving, patient, stubborn animal from the cold, storm-swept plateaus of Tibet. The yak has to be patient, for his age-long owners and drivers have been the Tibetans. He has to be stubborn, or he could never have survived association with them. But what is more to the point, he can endure the worst winters in the world—worse even than the weather they make at Medicine Hat.

As mates for the yak, the Canadians have brought in some Galway cattle—those rough-coated, hardy beasts that can thrive in the stormy west of Ireland country. The yaks and the Galways must have realized a mutual affinity bred of their respective upland homes, for they have taken kindly to each other, and the result of their union is known as the "Galyak", an animal looking rather like a long-haired cow, but still swinging astern the long, white-ended, sacerdotal brush of a tail that is the pride of the yak. (There is, by the way, a human precedent for this Irish-Tibetan cross: see Kipling's gorgeous story about Nam-

gay Doola.)

The Galyak is the serious effort of the Canadian breeders, but they have also tried a cross between the yak and the bison. Only one of these hybrids has ever been produced, and it is certainly a most strange creature. In body outline it is intermediate between bison and yak. It wears its coat thick all over, yak-fashion, instead of heavy in front and thin behind, like a bison. What it may be like in temperament must be a puzzle to its keepers, for the bison is an unstable, stampedeable animal, while the yak wouldn't go faster than three miles an hour if you built a fire under it. But whatever may be the use or interest of this yakson or bi-yak, whichever you may choose to call it, certainly its zoological cousin the Galyak gives promise of being an animal of real value on the Northern Canadian range.

Northward still, on the Alaskan tundras, where no imaginable hybrid of the domestic cattle could gain a living, a considerable livestock industry based on the reindeer has grown up, and large groups of Eskimo have abandoned their old nomadic hunting life to become well-to-do herdsmen. The reindeer are descendants of animals imported from Siberia by the Department of Agriculture about a generation ago. There is in Alaska and Northern Canada a native cousin of the reindeer, the caribou. This animal is the staff of life of hunting tribes of Eskimo, but it has never been domesticated. It is a larger animal than the European reindeer and has more meat on it, so that experiments are being made in the crossing of the two stocks. The hybrids are undoubtedly better meat animals, and can probably scrape a living out of the snow more effectively than their European cousins. If they can be kept in herds (the wild caribou tends to scatter rather than to bunch), and if they prove tractable as draft animals the cross will be rated a big success. It may be that a few years hence Santa Claus will come round to the U. S. Department of Agriculture to trade in his present team for a sextet of the new-model caribou-reindeer.

The old dictum that hybrids are all sterile and can't reproduce has, of course, been handled pretty roughly in all these experiments. In some cases it holds, in others it doesn't. Anyhow, the doctrine seems to have been established originally by reference to the most familiar of domestic hybrids, the mule. (Turn to page 197)

Foolproof Matches and Cigarettes

Economics

Discarded cigarettes and matches will cause fewer fires if manufacturers adopt the methods of fireproofing suggested by tests recently conducted at the United States Bureau of Standards.

Fire loss statistics collected by the National Board of Fire Underwriters attribute about one-sixth of the property loss from known causes to matches and smoking. If the same ratio holds for the loss from unknown causes, for the unreported loss and for the original cause of communicated fires, matches and smoking are responsible for a property loss near \$90,000,000 per year. If some of the methods of making the cigarettes and matches go out sooner after they are thrown away are adopted, P. D. Sale, who conducted the experiments at the Bureau, believes that this loss might be reduced considerably.

Hundreds of cigarette butts were collected to determine what length is usually discarded unused. It was

found that the average smoker throws his cigarette away with an inch and a quarter unburned, while less than two per cent. of the butts are smoked down to the last quarter inch.

Approximately 170,000 cigarette stubs are discarded every minute, and laboratory tests, duplicating as nearly as possible an actual condition that might occur, indicated that from 50 to 90 per cent. of the butts falling on readily combustible materials such as the dry or nearly dry grass pad used in the tests, would, with a slight wind blowing, cause fires. The percentage of ignitions varied with the dryness of the grass and the wind velocity.

Under actual conditions most cigarettes do not fall lighted on inflammable materials, but the 250,000,000 discarded every day constitute an enormous fire hazard. The government is particularly interested in the problem because of the vast losses caused in public parks, national and privately owned forests, and public

buildings, by careless smokers. Over 30,000 fires are believed to have been caused by smokers in the public and private forests of the country in 1927, the latest year for which statistics are available, causing the burning over of 7,000,000 acres or more of land with a loss of more than \$6,000,000. So great has been the public loss that the Government has closed extensive areas of National Forest land to smoking during the forest fire season, and many large timber operators rigidly prohibit smoking in the woods by employees and visitors.

The problem was attacked by the Bureau of Standards, and in tests made to simulate the fire hazard incident to discarded smoking materials it was shown that cigarette tips can be applied that will smother the fire soon after they are discarded. It was found by using a cork tip an inch long, either plain or coated on the inside with water glass, a sodium silicate (*Turn to next page*)

Health Field Open

Hygiene

"We have not scratched the surface of the possibilities in the public health field," declared Dr. Louis I. Dublin of the Metropolitan Life Insurance Co. at the recent session of the New York Health Conference. In spite of the splendid work that has been done by various health agencies both official and unofficial, only a beginning has been made.

One-half of our population still lives in rural areas and the majority of this rural population has no public health service available. So far public health activities have made their greatest strides in the cities. The Cattaraugus County Health Demonstration has demonstrated that what may be accomplished in the cities is just as possible when applied to rural life, Dr. Dublin pointed out. However, carrying out public health activities in rural areas is more difficult and requires more money and more educational activity.

We need a standard by which the adequacy of public health services can be measured, Dr. Dublin added. Until we have such a standard, we cannot definitely measure adequacy of public health services, Dr. Dublin declared.

Airplanes Noisy if Engines Muffled

Aviation

By THOMAS CARROLL

Mr. Carroll is chief test pilot, National Advisory Committee for Aeronautics, Langley Field, Virginia.

As a fast military airplane dives toward the ground with a great noise perhaps you feel that the science of aviation is very backward in not providing airplanes with mufflers on the engine to quiet the noise.

If it were as simple as that the problem would have been solved long ago. Only recently it was reported that a great European inventor had made an airplane noiseless with a simple muffler on the exhaust.

But the sound of the engine exhaust is only a part, and a small part at that, of the noise of the airplane. Engine mufflers have been used for years and are very effective in cutting out the noise. These are not only of the type used in automobiles which baffle the flow of gas in a chamber, but there are many types specially designed to use the rapid passage of the plane through the air to assist in the muffling. These are arranged so that the exhaust gas is directed into a chamber which in

turn leads into a venturi or throat through which the air is passing at a rapid rate, thereby cooling the gas and muffling the noise.

But there are other sources of noises. The propeller for instance, makes as great a racket as the engine. Especially is this true of the newer metal propellers. Their howl or whine is deafening, like a sawmill sawing knotty boards. Here is a nice problem, one which has made the muffling of the engine look even easier than it is.

Some experimentation has been done. Manufacturing the propeller blades of some material which does not vibrate in the manner of metal has been tried. Wooden propellers make nearly as much noise and so do those of various compositions which have been in more or less general use. One solution of the propeller noise problem that has been suggested is the wrapping of the metal propeller with something like soft rubber. It appears to have some merit in stopping the noise but no one has come forward and shown us how to apply the rubber and make it stay on.

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Foolproof Matches and Cigarettes—Continued

substance, that the glow in the average butt would go out soon enough greatly to decrease the danger of fire. Laboratory tests with this type of cigarette compared with the untipped and uncoated variety showed that the number of fires caused when falling on dry grass was reduced some 90 per cent. Even the ordinary untipped cigarette partly coated with water glass cut down the fire hazard by 50 per cent. Other treatments found to have varying degrees of success were the use of asbestos paper, a double thickness of cigarette paper, and boric acid solution. These methods are not all believed to be commercially practical, however. Various length tips were applied to the average $1\frac{1}{4}$ inches usually discarded. It was found that a one-half inch tip would materially decrease the possibilities of causing fire and when this was lengthened better results were obtained.

S. H. Ingberg, chief of the fire resistance laboratory, of the Bureau of Standards, under whose supervision the experiments were made, said:

"It is difficult to state how these tips would affect the popularity of the cigarette. With the tips tried there may be some change in taste where the cigarette is smoked up into the tip and it would have to be smoked rather continuously to utilize this portion. However, further work may indicate the possibility of overcoming whatever disadvantage this might imply."

Although the tipping smothers the fire only in the last inch or less of the cigarette, it was found by observation that the longer butts are usually discarded at car stops and entrances to buildings, where there is little danger of their causing fires.

Having found a possible method of reducing the smoldering cigarette fire hazard, the engineers next turned their attention to making the unused portion of matches less hazardous.

The average cigar and pipe smoker takes from 6 to 14 seconds to obtain a light from a match, while lamps, lanterns and cigarettes are lighted in an average of half that time. The ordinary match burns from 15 to 30

seconds, depending on the position in which it is held, so it was estimated that a portion of the stem could be fireproofed without detracting greatly from its usefulness. The common paper pad match was found to be the greatest offender in causing fires, due to its paper composition, while the safety match was found to be less destructive.

By coating all but the one-half-inch next to the head with the same water glass preparation used in the cigarette tests, the possibilities of ignition were reduced approximately one-third in laboratory tests. Production and import statistics indicate that about 290 billion matches are used annually, or an average of 550,000 a minute. The match fire hazard is particularly great because there is an actual flame instead of a glow as in the case of the cigarette, so that a fire is caused almost every time a lighted match is carelessly thrown on inflammable material.

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Grapefruit peel is being tried out as fertilizer in the South.

The Scientist's Jig-Saw Puzzle

General Science

A. E. EDDINGTON, in *The Nature of the Physical World* (Macmillan):

The philosophic trend of modern scientific thought differs markedly from the views of thirty years ago. Can we guarantee that the next thirty years will not see another revolution, perhaps even a complete reaction? We may certainly expect great changes, and by that time many things will appear in a new aspect. That is one of the difficulties in the relations of science and philosophy; that is why the scientist as a rule pays so little heed to the philosophical implications of his own discoveries. By dogged endeavour he is slowly and tortuously advancing to purer and purer truth; but his ideas seem to zigzag in a manner most disconcerting to the onlooker. Scientific discovery is like the fitting together of the pieces of a great jig-saw puzzle; a revolution of science does not mean that the pieces already arranged and interlocked have to be dispersed; it means that in fitting on fresh pieces we have had to revise our impression of what the puzzle-picture is going to be like. One day you ask the scientist how he is getting on; he replies, "Finely. I have very nearly finished this piece

of blue sky." Another day you ask how the sky is progressing and are told, "I have added a lot more, but it was sea, not sky; there's a boat floating on the top of it". Perhaps next time it will have turned out to be a parasol upside down; but our friend is still enthusiastically delighted with the progress he is making. The scientist has his guesses as to how the finished picture will work out; he depends largely on these in his search for other pieces to fit; but his guesses are modified from time to time by unexpected developments as the fitting proceeds. These revolutions of thought as to the final picture do not cause the scientist to lose faith in his handiwork, for he is aware that the completed portion is growing steadily. Those who look over his shoulder and use the present partially developed picture for purposes outside science, do so at their own risk.

The lack of finality of scientific theories would be a very serious limitation of our argument, if we had staked much on their permanence. The religious reader may well be content that I have not offered him a God revealed by the quantum theory, and therefore liable to be swept away

in the next scientific revolution. It is not so much the particular form that scientific theories have now taken—the conclusions which we believe we have proved—as the movement of thought behind them that concerns the philosopher. Our eyes once opened, we may pass on to a yet newer outlook on the world, but we can never go back to the old outlook.

If the scheme of philosophy which we now rear on the scientific advances of Einstein, Bohr, Rutherford and others is doomed to fall in the next thirty years, it is not to be laid to their charge that we have gone astray. Like the systems of Euclid, of Ptolemy, of Newton, which have served their turn, so the systems of Einstein and Heisenberg may give way to some fuller realization of the world. But in each revolution of scientific thought new words are set to the old music, and that which has gone before is not destroyed but refocussed. Amid all our faulty attempts at expression the kernel of scientific truth steadily grows; and of this truth it may be said—The more it changes, the more it remains the same thing.

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Separated Twins Become Unlike

Genetics

The old, old question that scientists are always asking about the rival claims of the influences of heredity and environment has received fresh impetus from the discovery of twin sisters who have been separated since infancy. Dr. H. H. Newman of the University of Chicago, who has made a special study of twins, has been searching for years for just such a case, of which only one other instance has hitherto been studied and recorded in scientific literature.

The girls, said Dr. Newman in a report to the *Journal of Heredity*, were born about twenty years ago in the Chelsea district in London. When they were eighteen months old their mother died. One of her twin daughters, whom Dr. Newman designates as O., was adopted by relatives who shortly after moved to Canada. The other twin, called A., was cared for by friends of the family and lived in London until her foster parents died, when she rejoined her sister, at her home in a small town in Ontario. They had

been separated about seventeen years.

The difference between a small Canadian town and a crowded section of London presents as wide a variation in environment, said Dr. Newman, as one is ever likely to find in the case of separated identical twins. If such circumstances are effective in shaping mental and emotional characters it should show up in such a case, he added.

Physically the less favorable conditions of London, particularly during the lean war years, would appear to have had their effect, for the English twin is about nine pounds lighter than her sister though their resemblance, in spite of her thinness, is very marked.

Both twins received a public school education through the equivalent of the grammar grades and both took a two-year business course, finishing at sixteen, and have worked in offices ever since. The mental and intelligence tests administered by Dr. Newman and his assistants showed, however, a wide dif- (Turn to next page)

Watch for Ice Started

Navigation

The annual springtime watch for ice on the North Atlantic, begun in 1914 in order to prevent the repetition of a disaster such as befell the *Titanic*, is now under way. The two U. S. Coast Guard cutters, *Tampa* and *Modoc*, are alternating in the service during March, April, May, June and as much longer as proves necessary.

The object of the ice patrol service, it is announced by the U. S. Navy's Hydrographic Office, is to locate icebergs and field ice nearest to the North Atlantic steamship lanes. The patrol vessel on duty will determine the southerly, westerly and easterly limits of the ice, and keep in touch with these fields as they move southward. Regular radio messages will be sent out daily giving the location of the ice.

Each day at 7:30 p. m., Eastern Standard Time, the patrol vessel sends a report of the ice to the Hydrographic Office, Washington, following it later in the night by supplementary reports if they are needed. This information is then given publicity by means of the Hydrographic Office's daily ice bulletin, and is broadcast twice each day in code from stations at Washington, Boston, New York

and Norfolk. In addition, a ship can secure information about the ice at any time by radio from the patrol vessel itself.

In order to aid the work of the ice patrol the Hydrographic Office has asked that steamships cooperate by reporting to the patrol vessel any icebergs or obstructions that they may sight, and also surface temperatures of the water at intervals of four hours. In this way, it is hoped to locate more accurately the branches of the Labrador current.

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Egyptians Had Magnifiers

Optics

When the eyesight of Egypt's wise men grew feeble from study they used magnifying glasses to make the stone tablets and papyrus rolls easier to read. This is indicated by pieces of round glass from Egypt, one of which, now in the Ashmolean collection, may date back to the first dynasty of Egypt, or about 3500 B. C. That magnifying glasses were known in the famous civilization of Crete, about 1200 B. C., had been shown by two crystal lenses discovered in the Cretan ruins.

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NATURE RAMBLINGS

By FRANK THONE

Natural History



Tarantulas

In practically every community, early spring brings its grocery-store tarantula scare. The honest merchant, handling a new bunch of bananas, is frightened out of a month's growth by finding a hairy monster of a spider nestling among the fruit, which, if it is not mashed by a broom or otherwise hopelessly ruined in the subsequent chase, is exhibited to shuddering customers amid terrible tales of the viciousness and venomous nature of the "reptile".

It is a terrible thing to throw cold water on any one's heroism, but the dull, gray truth remains that the tarantula, even the tropical tarantula smuggled in from Central America, is not as bad as her reputation. She cannot jump for surprising distances; her best performance is only inches where the romancers have given her yards. And as a rule she is too stupefied from her sojourn in cold storage to want to do any jumping at all.

Neither is her bite instantaneously fatal, as is frequently believed. So far as authentic records go, it is not fatal at all, except possibly in the case of small children or adults of very delicate constitution. It is unquestionably poisonous and very painful; it may put the victim into the hospital for days, and is almost certain to cause severe nausea and headache.

Only the tarantula very rarely strikes. She can be handled safely if treated gently, and even likes to be stroked. But it is not likely that the average person will want to go that far with the lady.

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London rose rapidly as a community in Roman days and became one of the largest towns of the Roman Empire.

For the Teaching of Chemistry

For the teaching of Chemistry, as well as for instruction in other sciences, it is generally admitted that there is no equipment that enjoys the prestige and reputation among educators to the extent of



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Dawn Man's Brain

Anthropology

E. O. JAMES, in *The Beginnings of Man* (Doubleday Doran):

In view of the existence of *Eoanthropus*, with a brain case having a marked similarity to that of *Homo sapiens*, in a period almost certainly anterior to that of the Neanderthal type, it would be illogical to suppose that the apparently intellectually superior Piltdown race was necessarily inferior to its successors in respect of religious emotions. The brain of the "dawn man," though small, comes definitely within the range of variation in size found in modern man. Of course, mere volume of brain is not the only criterion of mental superiority, but, as Elliot Smith has shown, a brain must reach a certain size and weight—950 grammes, or 1,000 c.c. in volume—before it can be the seat of human intelligence. Growth in volume continues till a certain maximum weight is reached; then *development* takes the place of growth, the brain elements entering into more and more complex relations with each other without much increase in size and number.

We now know that it is in the pre-frontal region (*i.e.*, the front part forming the forehead) that the higher mental faculties are centered, and consequently stupidity and dementia follow from the degeneration of this area. In spite of the complexity of the spinal cord, and still more of the medulla and cerebellum, no process confined to these structures involves human consciousness. True conscious physical activity belongs to the fore-brain, and almost entirely to the folded layers of gray matter covering the cerebral hemispheres—the so-called cerebral cortex. In *Pithecanthropus* this region was undeveloped, showing that the creature was of low intelligence, and in the Neanderthals it is not fully developed, having a protuberance as in the brain of the anthropoids. The left frontal lobe in particular, which is associated with the power of speech, is not much developed in the lower part, so that probably the cave men had a limited power of speech. In *Homo sapiens* the inferior or third frontal convolution is expanded so as to reach back to the stem of what is called the fissure of Sylvius, forming the anterior boundary of the stem, this new orbital part of the frontal lobe being associated with the faculty of speech. In Sir Arthur Keith's reconstruction of the Piltdown brain, the third frontal convolution reaches the human

Separated Twins—Cont'd
ference in intellectual attainments, with O., the Canadian twin, always rating consistently higher. Yet both the family judgment and psychological tests showed that emotionally and temperamentally they were very much alike.

Just the opposite state of affairs obtained in the first pair of twins to be studied scientifically, described about four years ago by Dr. H. J. Muller of the University of Texas. These twins were very similar in their mental ability and showed considerable variation in emotional traits. It would be premature, Dr. Newman pointed out, to base any very final conclusions on the study of just these two cases, that either emotional or intellectual characters are more strongly inherited or influenced by such outside factors as environment and training. He has succeeded in running down four other sets of separated twins and hopes from the study of these additional cases to obtain more conclusive evidence on this important subject.

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standard, and it is even more prominent in Sir Smith Woodward's cast. Therefore, while some of the parts which develop latest in ourselves were defective in *Eoanthropus*, he was nevertheless far removed not only from the "dumb animals," including the gorilla and even *Pithecanthropus*, but also from *Homo Neanderthalensis*.

In view of these somewhat technical anatomical facts, the Piltdown race is seen to be quite definitely human, and if we are compelled to grant the religious emotion to the cave man, it would be illogical to suppose, in the absence of definite evidence to the contrary, that the earlier species, possessing a brain in so many ways like our own, was inferior in this respect. Religion, therefore, was practised in all probability in the Lower Palaeolithic, and it may have been part of the original endowment of mankind, though at present we have no positive evidence before the time of the Mousterians.

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An "endless" phonograph record which could be used to record an entire opera or symphony has been produced by a British inventor.

Indian summer is not a season, but is simply a name for any spell of warm autumn weather following a cold snap.

America a Melting Pot for Animal Stocks—Continued



ZEBRA-HORSE AND ZEBRA-ASS HYBRIDS, in the National Zoological Park, Washington, D. C.

Mules as a rule do not breed, yet in the recent past two undoubted cases of mule mares giving birth to healthy foals have come to light.

"Old Beck" is only an ancient Texas "cotton mule" mare who has been on this planet long enough to vote, but she has done her bit toward breaking the age-old reproach of sterility leveled at her hybrid race. For she has not only borne offspring—two lusty colts—but now has a grand-child. For a mule to have a foal is an almost miraculous rarity, but for one of these to propagate is practically unheard of.

Yet this is the record of "old Beck," as reported by A. H. Groth of Texas A. and M. College. Her first offspring was a daughter, sired by a jack, and foaled in 1920. This feat brought her to the attention of the college authorities, and she was soon given a home on the campus. Subsequent matings with other jacks failed to produce another colt, but a noted stallion of the college stud sired a foal that has grown up to look quite like a horse—and a fine horse at that.

"Old Beck's" mule daughter has remained without issue, in spite of several attempts to breed her, but the horse-like colt, a stallion, has sired one healthy colt, now over a year old.

Mr. Groth says of him, "He has developed into a nicely balanced horse of saddle type. . . . He per-

forms well under saddle and is possessed of remarkable intelligence. The only mule characteristic which he shows is his dislike for crossing a ditch or stream."

Erasmus Haworth of Lawrence, Kans., records another case of a mule mare producing a foal sired by a jack. The same mule is now believed to be with foal a second time.

Every once in a while some one takes a notion to hybridize the zebra with the horse or the donkey. It isn't especially hard to do, for all three animals are fairly closely related—as closely, say, as cattle and zebu are, and more closely than cattle and bison. The offspring are called by various names, such as "zebrass" and "zebrule". As a rule they are of no practical use, for they usually inherit the wild intractability of their striped ancestors; but at any rate they are interesting animals and make nice specimens for zoos. At present the U. S. Zoological Park in Washington has two of these zebra hybrids, one a cross between zebra and horse and the other between zebra and ass.

The question of the hybrid origin of some of our breeds of dogs is frequently agitated. The dogs that look more or less like wolves, especially German police dogs, Alsatian shepherds and Eskimo "huskies", are often declared to be "part wolf", and their occasional outbreaks of temper

ascribed to this supposed lupine ancestry. Nothing is known with any certainty about all this, except that presumably the Stone Age ancestors of all tame dogs were originally all wild dogs captured as puppies and reared in captivity, tumbling around with the Stone Age kids on the floor of the Stone Age cave or tent. But there would be nothing incredible about crossing wolf into dog stock or vice versa, for zoologically dogs and wolves are much more nearly related than cattle, bison, zebu and yak. These various bovines are all distinct species, while all varieties of dogs are rated as belonging to the same species, which includes also the most widespread species of wolf, the big lobo or timber wolf. One interspecific hybrid at least has been made, crossing shepherd with the prairie wolf or coyote. The pups were "cute" enough when they were small, but at six months of age the ignoble coyote traits displayed themselves in such habits as persistent chicken stealing. The mating had not been what the Almanach de Gotha would rate as "of equals", and the curse rested on the offspring.

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Flies Aid Medical Studies

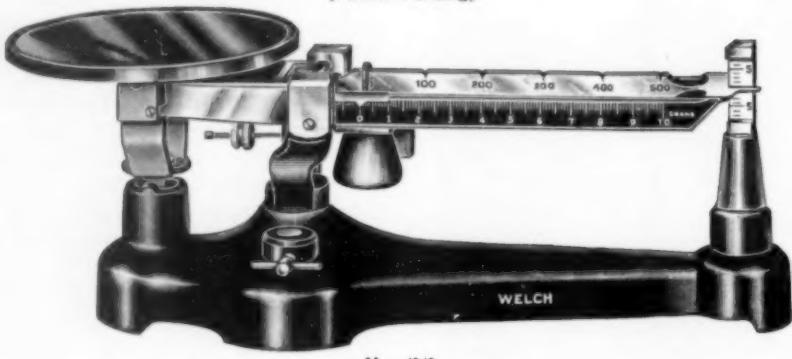
Genetics

Flies which have long been held in bad esteem as spreaders of disease are about to do their bit in helping the human race. They are being used now for studies of the effect of X-rays on future generations. In flies, the harmful effects of these rays appear in the third and fourth generation, Dr. Mary B. Stark of New York City reported recently. She has exposed flies to X-rays for varying lengths of time. While the individuals exposed continue to grow and breed, their descendants die off. Dr. Stark believes this is because the reproductive cells of the grandparent or great-grandparent flies were injured by the rays. This injury is inherited and finally causes death. In this same way cancer may be produced in the third and fourth generations of flies. Dr. Stark believes that the experiments on flies will throw some light on this problem in human beings. Her theory is not accepted by all scientists, however. Because the human race breeds slowly, it will be some time before the inherited effects of X-rays can be noticed in man.

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Do You Know That—

Thirty different plows are being tested in the corn borer area near Toledo, Ohio, to compare their usefulness in destroying the pests by plowing under cornstalks and refuse.

The case of a man who developed a body temperature of 110.6 degrees and survived is reported in a western medical journal and is said to be the highest authentic record of this kind ever reported.

Vast pulp timber resources in southeastern Alaska indicate that this region could develop a great paper making industry.

A new dial to add to the automobile dashboard has figures which can be set to match the speedometer mileage reading when the oil is changed, and the figures remain stationary to remind the motorist when he will need fresh oil.

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"Brotex" Doubted

Agriculture

"Brotex," the much-talked-of new fiber plant which has been hailed in the press as a "replace-plant" for cotton and a solution of Britain's textile woes, is apparently being received coolly and even somewhat doubtfully by British scientists. An editorial paragraph in *Nature*, leading British scientific journal, examines the claims of the new plant critically and dismisses it, at least for the time being, with a Scotch verdict.

"That a plant with so many desirable qualities, which will survive the winter in the south of England, should only now have been brought to notice, is somewhat remarkable and merits further investigation," the editor remarks.

"The 'evolution of the plant' has not been disclosed, pending application for patents, though it has been stated elsewhere to be of hybrid origin. It is known, however, that it belongs to the genus *Lavatera* of the family of Malvaceae, and the plants now being grown in Devonshire very closely resemble a species which is a native of the Canary Islands, a plant which would certainly be hardy only near the warm southwest coast of England in normal winters. The mallow family contains many well-known fiber-yielding plants, . . . and in some cases the seeds are also of value for cattle food. None of these plants is hardy in Great Britain, and even *Lavatera arborea*, which is the only *Lavatera* found in England, will succeed only near the coast.

"If, therefore, 'Brotex' can be proved to be of hybrid origin, not only will it be of scientific value to know its parentage, but it will also be of material importance to know whether it will regularly produce fertile seed in Great Britain. Moreover, it is of importance, from the commercial aspect, to know whether the fiber is superior to jute and hemp, with which fibers we understand the market is already fully supplied."

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An investigation of habits of 300 children of the fourth, fifth, and sixth grades showed that the average child gets enough sleep, though some do not.

A sedan-style automobile which can travel on rails has been especially constructed for inspection trips over a Canadian railway line.

Seek Fossils in Southwest

Paleontology

More bones of extinct ground sloths and of other beasts that roamed the earth in their time are the objectives of a joint expedition by the Smithsonian Institution and the Peabody Museum of Yale University, which just left for New Mexico. The scientists will go to the extinct volcanic fumarole in Dona Ana County, N. M., about 45 miles northwest of El Paso, Texas, where the giant ground sloth whose bones are now in the Peabody Museum was found last year. They expect to clean this place out completely, removing and sifting tons of guano which have been deposited by uncounted generations of bats, in the search for even the tiniest of skeletal remains.

The place where the sloth was found by a group of amateur explorers has been described as a "cave." It is not a cave in the proper sense of the term, but a crevice in the ground, narrow at the mouth and broader at the bottom, forming a natural pit trap. Into this the

How Warm is a Wren?

Ornithology

That Mrs. Wren's children often "develop temperatures" has been revealed, along with other facts concerning the domestic life of the now famous wren families that have been under observation for a number of years at Hillcrest Farm, Gates Mills, Ohio, where the Baldwin Research Laboratory is located. As a result of inquiries into the private life of this bird from egg to parenthood, it is evident that the infants of wren-dom are capable of registering temperatures that would alarm any young mother.

In carrying on experiments in taking bird temperatures, thermocouples and mercury thermometers especially adapted for this study were used. Over sixty young birds were observed in the 3,300 readings obtained at Mr. Baldwin's laboratory during the last two summers. In order to secure information on the extent of variation in the body temperature of nestling wrens from day to day, during the developing period, a set of experiments under controlled conditions was devised.

The bird under study was placed in an incubator, and a series of readings taken by inserting the thermocouple deep into its mouth. Each experiment required between two and four hours.

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luckless sloth tumbled many thousands of years ago; and it is the belief of the members of the expedition that other animals may have shared the same fate and left their skeletons to be covered by the slowly accumulating guano.

All bones found will be divided equally between the two participating institutions, with the understanding that if another ground sloth is discovered it is to go to the U. S. National Museum.

The Peabody Museum will be represented by Fred W. Darby, and the U. S. National Museum by N. H. Boss. Ewing Warehouse, of El Paso, one of the discoverers of the Yale sloth, will assist the party. It is expected that the work will keep the party afield during April and May, and it is planned also to examine all similar holes and caves which may be discovered in this region, in the hope of a repetition of last year's landfall.

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200 Quakes in Year

Seismology

Nineteen twenty-eight was a record year for Mexican earthquakes.

During the first six months over 200 quakes were registered, the first one on New Year's Day.

A seismic geography of the country has been compiled from the records, and also from visual observations of such obvious earth modifications as cracks in the ground and landslides, by the Institute of Geology in Mexico City. It contains a seismic map which may have to become a guide to architectural styles in the future.

Nervous inhabitants of the capital and the surrounding valley appeal for moral assurance to the Geological Institute when the earth begins its newest step. An ancient Indian legend says that Tenochtitlan, now Mexico City, will some day be destroyed by volcanic fire, and a German scientist, Von Humboldt, declared a century ago that the little hill, "El Penon," in the middle of the valley, may some day do it.

The 1928 Mexican quakes have nearly all been in the southern states of Oaxaca and Guerrero, and sometimes in the sea offshore. The inhabitants there have evolved an earthquake complex, from the terrifying noises sometimes accompanying the quakes.

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The Evolution of the Brain

Neurology

G. H. PARKER, in *The Mind and Its Growth—Yale Review, Spring, 1929*.

It has long been known that the central nervous organs of the backboned animals are primarily the spinal cord and the brain. In man the weight of the average brain is 1,360 grams, or almost exactly three pounds. The human spinal cord, which stretches downward through the back, weighs only some 26 grams, or about a fiftieth part of the brain. This disproportion is characteristic of the higher animals and especially of man. But in the frog the brain and spinal cord weigh one about as much as the other. In many fishes the weight of the brain is only a small fraction of that of the cord. In fact, in these animals the brain often seems little more than a slight modification of the front end of the cord. The series of animals from fish to man shows at once that of the two central organs, cord and brain, the former has changed very little, and in its conservatism it is in strong contrast with the brain, which not only in volume but also in complexity of structure has progressed prodigiously in the course of development.

Since in the evolutionary sequence receptors arose in advance of central organs, it is natural to expect that central organs would be moulded in their growth by the sense organs with

which they were associated, and such seems to be the case. Thus in the backboned animals the chief sense organs of the head are, beginning at the front, the nose, the eye, and the ear. Under these three pairs of organs has developed the brain, which in obedience to its sensory surroundings is divisible into an olfactory segment, an optic segment, and what may be called a positional segment, for the internal ears of vertebrates are, in general, more concerned with bodily equilibrium than with hearing.

In the lower forms the stem is practically all there is to the brain, but in higher vertebrates two additional organs appear. The first is the cerebellum, an upgrowth from the positional segment and a part that is concerned with the regulation and control of muscular activity. The second part includes the cerebral hemispheres, which are upgrowths from the olfactory segment and are at first probably entirely concerned with smell. They carry a very important covering of nervous material called the primitive mantle, or archipallium. In the higher vertebrates and particularly in the mammals this primitive mantle is crowded aside by the excessive growth of the so-called new mantle, or neopallium, which is a nervous surface upon which are reflected, as the sense of smell is reflected on the archipallium, all the senses of the body and from which

emanate the great nerve tracts for the voluntary movements. The old and new mantles thus together constitute an immense field for the assemblage of the chief sensory activities of the individual and also for the discharge of the impulses for volitional responses. This portion of the brain, particularly the part designated as the new mantle, shows a greater growth and differentiation among the mammals and especially the higher mammals than any other portion of the central organ. In man these parts are represented by that convoluted surface of immense complexity that occupies almost the whole of the outer aspect of the brain. . . .

Not only is this mantle of the brain a surface on which are projected the chief sensory and motor activities, but it is also the center for all the higher nervous functions. Here is our real organ of sensation; here the emotions have their processes that make up thinking, and from this center emanate our impulses to activity. This is the part of our body that is concerned with hard mental work, with philosophizing, with imagining, with the passions, and with all those higher activities that tend to make man different from the brute. If we are forced to seek a seat for the soul, this surely is it.

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Slaughter

Zoology

E. DOUGLAS BRANCH, in *The Hunting of the Buffalo* (Appleton):

At the first crack of his "pizen slinger" the hunter jumped to his feet and ran after the buffalo. They usually ran from fifty to a hundred feet at the first shot, and a speedy pursuer could go half that distance in the same time. "Then we would drop down and lam it into the first broad side we saw. Then we would have to jump up and run again. This time they would run not quite so far nor so fast, and after we repeated this game a few times we could hold our own with them."

There was some danger in this running, for the hunter had to pass by the first buffaloes he had shot, and sometimes the sight of the hunter brought them to their feet; but a second shot was usually all that they needed.

The vital spot of a buffalo—his heart—was to be reached by a shot fired from a point a little in his rear, the hunter aiming just behind the shoulder blade, and about two-thirds down from the top of the hump. A single shot well placed was quite enough to bring down the most formidable old bull. With the most accurate hunting rifle ever made—the Sharp's gun—and a large mark within easy range, a good hunter could make nearly every shot bring down a mortally wounded buffalo. But the old hunters believed "A buffalo will not die as long as he is angry."

If the herd was at rest, the hunter might make a "stand"—his most precious maneuver. The leader of the herd was the one to be shot down first. "The noise startles the buffaloes, they stare at the little cloud of white smoke and feel inclined to run,

but seeing their leader hesitate they wait for her. She, when struck, gives a violent start forward, but soon stops, and the blood begins to run from her nostrils in two crimson streams. In a couple of minutes her body sways unsteadily, she staggers, tries hard to keep her feet, but soon gives a lurch sideways and falls. Some of the other members of the herd come around her and stare and sniff in wide-eyed wonder, and one of the more wary starts to lead the herd away. But before she takes a dozen steps 'bang!' goes the hidden rifle again, and her leadership is ended forever. Her fall only increases the bewilderment of the survivors over a proceeding which to them is strange and unaccountable, because the danger is not visible.

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FIRST GLANCES AT NEW BOOKS

AMERICAN PLANTS FOR AMERICAN GARDENS—Edith A. Roberts and Elsa Rehmann—*Macmillan* (\$2). The gospel that we should depend on worthy native ornament trees and shrubs, instead of the inevitable transplanted Europeans and Orientals which most nurserymen will foist on us if we give them a chance, has been well preached and is beginning to be well accepted. But the present authors take a long and most praiseworthy step in advance of this. They show the home owner how to select the particular native species that will be ecologically at ease in the background he gives them: prairie plants for the prairie setting, pinewoods plants for a home in the pines. The really knowing home planter will welcome this book with enthusiasm.

Horticulture—Ecology

Science News-Letter, March 30, 1929

HOW YOU BEGAN—Amabel Williams-Ellis—*Coward McCann* (\$1.20). Elementary embryology, trimmed down to small-child's size vocabulary. A good deal of the recapitulation theory gets in, of necessity; and there is an extra chapter on evolution in general. J. B. S. Haldane writes an enthusiastic introduction.

Biology

Science News-Letter, March 30, 1929

MY ANIMAL FRIENDSHIPS—Cherry Kearton—*Dodd, Mead* (\$1). Adventures in friendship with a rat, a cheetah, a mongoose, a penguin, an elephant and a spider, told for children.

Zoology

Science News-Letter, March 30, 1929

SAFARI—Martin Johnson—*Putnam's* (\$5). How you get to Big Game land, what you see and do when you get there, and how you come home again, fascinatingly told by one of the world's best-known travelers into little-known places.

Travel—Zoology

Science News-Letter, March 30, 1929

IN JAVA—John C. Van Dyke—*Scribner* (\$2.50). Seas and towns, rivers and mountains, men and animals of a far-away world brought home by a traveler who knows how to look sharply and comment tersely.

Geography—Natural History

Science News-Letter, March 30, 1929

THE MEANING OF LIFE AS SHOWN IN THE PROCESS OF EVOLUTION—C. E. M. Joad—*Watts*—(7 d). A brief treatise from the rationalist's point of view.

Evolution

Science News-Letter, March 30, 1929

POPULAR PSYCHOLOGY—A. A. Roback—*Sci-Art, Cambridge* (\$2.50). An introduction to psychology for the reader who shies at wading through a college text, but who is looking for a book that will answer his questions on psychology. There is a long chapter on what psychology is; then one hundred questions that the reader may answer to test his memory and understanding of the facts; then exercises and problems; discussions on character analysis, emotions, psychoanalysis; a list of psychological publications, and so on. The book is called a handbook rather than a text.

Psychology

Science News-Letter, March 30, 1929

AN ANTHOLOGY OF RECENT PHILOSOPHY—Daniel Sommer Robinson—*Crowell* (\$4). Philosophy is often considered a subject which is the peculiar property of past ages and yet here is a compilation of the writings, not of the ancient philosophers, but of those of our own time. Among the names of those from whom selections are taken are William James, Will Durant, John Dewey, J. H. Muirhead, Bertrand Russell, George Santayana, Oswald Spengler.

Philosophy

Science News-Letter, March 30, 1929

DEVELOPMENT AND PURPOSE—L. T. Hobhouse—*Macmillan* (\$6). Mental evolution has consisted in the development of consciousness, particularly self-consciousness, in the opinion of this well-known philosopher. The growth of this development is traced by him. Second edition revised.

Philosophy

Science News-Letter, March 30, 1929

WHAT IS THE MIND?—George T. W. Patrick—*Macmillan* (\$2.50). A professor of philosophy explains what mind is, in terms of psychology and of evolution. Views of Plato and other outstanding thinkers of the past are brought into the discussion, and their contributions are assayed in the light of modern knowledge, so that the reader may set in order the progress of thought on this age-old problem. That the subject of the mind is a live one scientifically at this time is shown by Dr. Frederick's statement that in the past fifty years more progress has been made in solving the riddle of the mind than in all the centuries since Aristotle.

Philosophy

Science News-Letter, March 30, 1929

THE SURGICAL OPERATIONS ON PRESIDENT CLEVELAND IN 1893, TOGETHER WITH SIX ADDITIONAL PAPERS OF REMINISCENCES—William W. Keen—*J. B. Lippincott* (\$1.50). At the age of 90 the venerable and venerated Dr. Keen recalls many interesting incidents of his life and shows what great changes have taken place in the practice of surgery during his long career. Besides the title topics, he gives in this volume personal recollections of Dr. S. Weir Mitchell, a sketch of Louis Pasteur, an episode of the second battle of Bull Run, and "What It Costs to Become a Doctor."

Medicine

Science News-Letter, March 30, 1929

CRAFTSMANSHIP AND SCIENCE—Sir William H. Bragg—*Watts* (7d). The brilliant presidential address delivered at the 1928 meeting of the British Association for the Advancement of Science, made available as a low-priced pamphlet.

General Science

Science News-Letter, March 30, 1929

ENRICHED TEACHING OF SCIENCE IN THE HIGH SCHOOL—Maxie N. Woodring, M. E. Oakes and H. E. Brown—*Teachers' Coll.* (\$1.50). A source book for teachers of science, listing chiefly free and low cost illustrative and supplementary materials.

Pedagogy

Science News-Letter, March 30, 1929

URBAN INFLUENCES ON HIGHER EDUCATION IN ENGLAND AND THE UNITED STATES—Parke R. Kolbe—*Macmillan* (\$2). Higher education in recent years has come to the city like many other functions of modern life. The effects that have been produced by this development are considered in this volume sponsored by the American Association for Adult Education.

Education

Science News-Letter, March 30, 1929

PHONOPHOTOGRAPHY IN FOLK MUSIC—Milton Metfessel—*University of North Carolina Press* (\$3). Music, so long an art, is becoming a science through the efforts of Dr. Seashore and his disciples. In the new notations of physics and psychology, through the use of phonograph and motion picture, Dr. Metfessel has preserved an indelible record of some of the peculiar folk music of the American negro.

Music—Psychology

Science News-Letter, March 30, 1929

Books—Continued

PHYSICAL REVIEW SUPPLEMENT—Published by the *American Physical Society* (\$4 per year). The first number of this new publication in physics, which will give opportunity for the issuance of resumes, discussions and lengthy treatments of material which cannot be included in the *Physical Review*, is scheduled for June.

Physics
Science News-Letter, March 30, 1929

A SHORT HISTORY OF CHINA—Edward Thomas Williams—*Harper's* (\$5). To present in less than seven hundred pages the history of a three-thousand-year-old civilization is no mean undertaking. This work is well presented and indexed—and never dry.

Oriental History
Science News-Letter, March 30, 1929

GEOGRAPHY AND OUR NEED OF IT—J. Russell Smith—*American Library Assn.* (paper, 35c., cloth, 50c.). Mr. Smith conceives of geography as the study—not of dry maps—but of an earth that is alive and interesting. This little book shows not only the need, but the fascination of geography study.

Geography
Science News-Letter, March 30, 1929

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CLASSICS OF SCIENCE:

Moseley's Atomic Numbers

Physics—Chemistry

In these classic researches Moseley solved the riddle of the true order of the elements, and explained the irregularities of Mendeleeff's periodic table.

The London, Edinburgh and Dublin PHILOSOPHICAL MAGAZINE and Journal of Science. Sixth Series.

The first extract is from Vol. XXVI, No. CLI, July, 1913; the second from Vol. XXVI, No. CLVI, December, 1913; the third from Vol. XXVII, No. CLX, April, 1914.

The Reflexion of the X-rays. By H. G. J. Moseley, M. A., John Harling Fellow, and C. G. Darwin, M. A., Lecturer in Mathematical Physics in the University of Manchester.

The discovery in July, 1912, by Friedrich and Knipping that the X-rays can show interference has opened up a new region to research. It had been suggested to them by Laue that the ordered arrangement of the atoms in a crystal would do the same for X-rays that a diffraction-grating does for light. They therefore sent a fine beam of X-rays through a thin crystal of zinc-blende on to a photographic plate. After prolonged exposure to the radiation the plate showed an elaborate system of spots surrounding the central image. These spots were caused by fine beams of X-rays, which came from the crystal. Explanations of this phenomenon have been offered by Laue and by W. L. Bragg. The following is a brief statement of W. L. Bragg's theory.

It is known that every atom in a crystal scatters a small fraction of the incident radiation. Since the atoms are regularly arranged these scattered disturbances have definite time relations. In certain directions a number of scattered disturbances reinforce one another, and so give rise to a new disturbance of considerable strength. The co-operating disturbances come from atoms which lie in a plane. This plane, the incident beam, and the direction of the new beam have the same geometrical relation as have a mirror, an incident ray, and the reflected ray. Wherever a plane containing many atoms can be drawn in the crystal a ray will be found in the direction which is the reflexion in this plane of the incident beam. The position of every spot in Friedrich and Knipping's photographs can be found from this principle. A cleavage-plane is exceptionally rich in atoms,



H. G. J. MOSELEY in his laboratory

and Bragg confirmed his theory by throwing a beam of X-rays on to a cleavage surface of mica, and observing a strong image in the position which an optically reflected beam would occupy.

The High-Frequency Spectra of the Elements. By H. G. J. Moseley, M. A.

. . . Twelve elements have so far been examined. The ten given in Table I were chosen as forming a continuous series with only one gap. It was hoped in this way to bring out clearly any systematic results. The inclusion of nickel was of special interest owing to its anomalous position in the periodic system. Radiations from these substances are readily excited, and the large angles of reflexion make it easy to measure the wave-lengths with accuracy. Calcium alone gave any trouble. In this case, owing to the high absorption coefficient of the principal radiation—about 1200^{-1} cm. in aluminum—the X-ray tube was provided with a window of goldbeaters' skin and the air between the crystal and the photographic plate displaced by hydrogen. The layer of lime which covered the surface of the metal gave off such a quantity of gas that the

X-rays could only be excited for a second or two at a time. Brass was substituted for zinc to avoid volatilization by the intense heat generated at the point struck by the cathode rays. Ferrovanadium (35 per cent. V) and ferro-titanium (23 per cent. Ti), for which I am indebted to the International Vanadium Co., proved convenient substitutes for the pure elements, which are not easily obtained in the solid form.

Plate XXIII shows the spectra in the third order placed approximately in register. Those parts of the photographs which represent the same angle of reflexion are in the same vertical line. The actual angles can be taken from Table I. It is to be seen that the spectrum of each element consists of two lines. Of these the stronger has been called alpha in the table, and the weaker beta. The lines found on any of the plates besides alpha and beta were almost certainly all due to impurities. Thus in both the third and second order the cobalt spectrum shows Ni alpha very strongly and Fe alpha faintly. In the third order the nickel spectrum shows Mn alpha₂ faintly. The brass spectra naturally show alpha and beta both of Cu and Zn, but Zn beta₂ has not yet been found. In the second order the ferro-vanadium and ferro-titanium spectra show very intense third-order Fe lines, and the former also shows Cu alpha₃ faintly. The Co contained Ni and 0.8 per cent. Fe, the Ni 2.2 per cent. Mn, and the V only a trace of Cu. No other lines have been found; but a search over a wide range of wave-lengths has been made only for one or two elements, and perhaps prolonged exposures, which have not yet been attempted, will show more complex spectra. The prevalence of lines due to impurities suggests that this may prove a powerful method of chemical analysis. Its advantage over ordinary spectroscopic methods lies in the simplicity of the spectra and the impossibility of one substance masking the radiation from another. It may even lead to the discovery of missing elements, as it will be possible to predict the position of their characteristic lines.

It will be seen from Table I that the wave-lengths calculated from the two orders are in good agreement. The third order gives the stronger reflexion, and as (Turn to next page)

Atomic Numbers—Continued

the angles dealt with are the larger these results are the more accurate. The similarity of the different spectra is shown by the fact that the two lines alpha and beta remain approximately constant, not only in relative intensity but also in relative wavelength. The frequency of beta increases, however, slightly faster than that of alpha. . . .

We have here a proof that there is in the atom a fundamental quantity, which increases by regular steps as we pass from one element to the next. This quantity can only be the charge on the central positive nucleus, of the existence of which we already have definite proof. Rutherford has shown, from the magnitude of the scattering of alpha particles by matter, that this nucleus carries a + charge approxi-

A
mately equal to that of — electrons,
2

where A is the atomic weight. Barkla, from the scattering of X-rays by matter, has shown that the number of

A
electrons in an atom is roughly —
2

which for an electrically neutral atom comes to the same thing. Now atomic weights increase on the average by about 2 units at a time, and this strongly suggests the view that N increases from atom to atom always by a single electronic unit. We are therefore led by experiment to the view that N is the same as the number of the place occupied by the element in the periodic system. This atomic number is then for H 1, for He 2, for Li 3 . . . for Ca 20 . . . for Zn 30, etc. This theory was originated by Broek and since used by Bohr. We can confidently predict that in the few cases in which the order of the atomic weights A clashes with the chemical order of the periodic system, the chemical properties are governed by N; while A is itself probably a complicated function of N. The very close similarity between the X-ray spectra of the different elements shows that these radiations originate inside the atom, and have no direct connection with the complicated light-spectra and chemical properties which are governed by the structure of its surface.

The High-Frequency Spectra of the Elements. Part II. By H. G. J. Moseley, M. A.

The first part of this paper dealt with a method of photographing X-ray spectra, and included the spectra of a dozen elements. More than

thirty other elements have now been investigated, and simple laws have been found which govern the results, and make it possible to predict with confidence the position of the principal lines in the spectrum of any element from aluminium to gold. The present contribution is a general preliminary survey, which claims neither to be complete nor very accurate. . . .

The results obtained for the spectra of the L series are given in Table II, and plotted in fig. 3. These spectra contain five lines, alpha, beta, gamma, delta, eta, reckoned in order of decreasing wave-length and decreasing intensity. There is also always a faint companion alpha prime on the long wave-length side of alpha, a rather faint line phi between beta and gamma for the rare earth elements at least, and a number of very faint lines of wave-length greater than alpha. Of these, alpha, beta, phi and gamma have been systematically measured with the object of finding out how the spectrum alters from one element to another. The fact that often values are not given for all these lines merely indicates the incompleteness of the work. The spectra, so far as they have been examined, are so entirely similar that without doubt alpha, beta and gamma at least always exist. Often gamma was not included in the limited ranges of wave-lengths which can be photographed on one plate. Sometimes lines have not been measured, either on account of faintness or of the confusing proximity of lines due to impurities.

Lines due to impurities were frequently present, but caused little trouble except in the rare earth group.

Conclusions

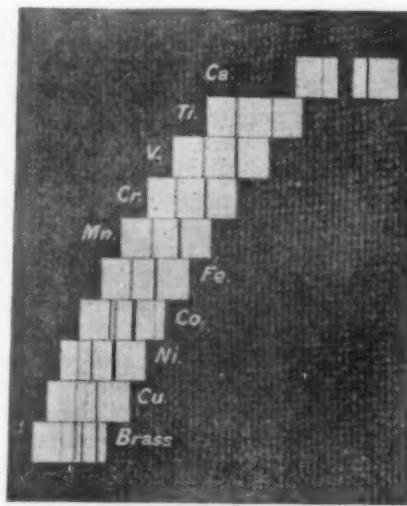
In Fig. 3 the spectra of the elements are arranged on horizontal lines spaced at equal distances. The order chosen for the elements is the order of the atomic weights, except in the cases of A, Co, and Te, where this clashes with the order of the chemical properties. Vacant lines have been left for an element between Mo and Ru, an element between Nd and Sa, and an element between W and Os, none of which are yet known, while Tm, which Welsbach has separated into two constituents, is given two lines. This is equivalent to assigning to successive elements a series of successive characteristic integers. On this principle the integer N for Al, the thirteenth element, has been taken to be 13, and the values of N then assumed by the other elements are given on the left-hand side of fig. 3. This proceeding is justified by the fact that it introduces perfect regularity into the X-ray spectra. . . .

Now if either the elements were not characterized by these integers, or any mistake had been made in the order chosen or in the number of places left for unknown elements, these regularities would at once disappear. We can therefore conclude from the evidence of the X-ray spectra alone, without using any theory of atomic structure, that these integers are really characteristic of the elements.

Now Rutherford has proved that the most important constituent of an atom is its central positively charged nucleus, and Van den Broek has put forward the view that the charge carried by this nucleus is in all cases an integral multiple of the charge on the hydrogen nucleus. There is every reason to suppose that the integer which controls the X-ray spectrum is the same as the number of electrical units in the nucleus, and these experiments therefore give the strongest possible support to the hypothesis of van den Broek. Soddy has pointed out that the chemical properties of the radio-elements are strong evidence that this hypothesis is true for the elements from thallium to uranium, so that its general validity would now seem to be established.

Henry Gwyn-Jeffreys Moseley (1887-1915) had barely completed the researches reprinted here when the World War and England's disastrous volunteer system of raising armies dragged him from the laboratory to death at Gallipoli.

Science News-Letter, March 30, 1929



X-RAY SPECTRA OF TEN ELEMENTS (Plate XXIII)